



*(University of Choice)*

**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**MAIN CAMPUS**

**UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR**

**SECOND YEAR SECOND SEMESTER  
EXAMINATIONS FOR THE DIPLOMA  
IN  
MECHANICAL AND INDUSTRIAL ENGINEERING**

**COURSE CODE: DME 082**

**COURSE TITLE: FLUID MECHANICS II**

**DATE: 27/04/2022**

**TIME: 12:00-2:00 PM**

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**INSTRUCTIONS TO CANDIDATES**

Answer Question **ONE** and any other **TWO** questions

**TIME: 2 Hours**

**QUESTION ONE****30MKS**

- a) Find an expression for the drag force on sphere of diameter  $D$ , Moving with a uniform velocity  $V$ , in the fluid of density  $\rho$  and dynamic viscosity  $\mu$ . Drag Force  $F$  is a function of  $D, V, \rho, \mu$ , use Rayleigh's method to determine the relationship between Drag Force  $F$  and the other variables. **(10mks)**
- b) The pressure difference  $\Delta P$  in a pipe of the diameter  $D$  and length  $L$  due to turbulent flow depends on the velocity  $V$ , Viscosity  $\mu$ , density  $\rho$ , and roughness  $K$ . Using Buckingham's  $\pi$  Theorem, Obtain an expression for  $\Delta P$ . **(10mks)**
- c) Derive on the basis of dimensional analysis, suitable parameters to present the thrust developed by a propeller. Assume that the thrust  $P$  depends upon the angular velocity  $\omega$ , speed of advance  $V$ , Diameter  $D$ , Dynamic Viscosity  $\mu$ , Mass density  $\rho$ , elasticity of the fluid medium which can be denoted by the speed of sound in the medium  $C$ . **(10mks)**

**QUESTION TWO****20MKS**

- a) Define and state **THREE** uses of dimensional analysis **(4mks)**
- b) Using Buckingham's  $\pi$  Theorem prove that the discharge over a spill way is given by the relation:

$$Q = VD^2 f \left[ \frac{\sqrt{gD}}{V}, \frac{H}{D} \right] \quad \text{Where; } V = \text{Velocity of flow, } D =$$

*Depth at the throat, H = Head of water and g = Acceleration due to gravity* **(10mks)**

- c) With a suitable equation, describe the following terms as applied to model analysis
- Dynamic Similarity
  - Geometric Similarity **(6mks)**

**QUESTION THREE****20MKS**

- a) State Newton's first, Second and Third laws **(3mks)**
- b) State **FOUR** advantages of centrifugal pump over reciprocating pump **(2mks)**
- c) A centrifugal pump has an impeller of outer radius  $r_2$  and inner radius  $r_1$  and the corresponding peripheral velocities are  $u_2$  and  $u_1$ . If the flow enters the impeller radially obtain an expression for the work done/unit wt on the fluid by the impeller in terms of  $u_2$  and the velocity of whirl at outlet  $w_2$  **(8mks)**
- d) The diameter of the impeller of a pump is 1.2m and its peripheral speed is 9m/s. Water enters radially and is discharged from the impeller with a velocity whose radial component is 1.5m/s. The vanes are curved backwards at exit and make an angle of  $30^\circ$  with the periphery, if the pump discharges 3.4m<sup>3</sup>/min, find the turning moment on the shaft. **(7mks)**

**QUESTION FOUR****20MKS**

- a) With the aid of a neat diagram explain the construction and working of a Pelton wheel turbine **(12mks)**
- b) A Pelton wheel is to be designed for the following specifications  
Power = 9560kw  
Head = 350m  
Speed = 750 rpm  
Overall Efficiency = 85%  
Jet diameter not to exceed  $1/6^{\text{th}}$  of the wheel diameter  
Determine the following
- The wheel diameter
  - Diameter of the jet
  - The number of jets required
- Take Coefficient of velocity,  $C_v = 0.985$   
Speed ratio,  $K_u = 0.45$  **(8mks)**

